

UAS for whale photogrammetry



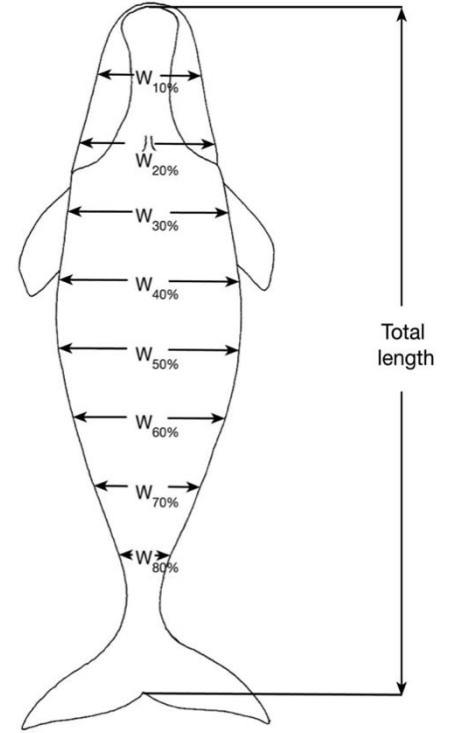
John.Durban@noaa.gov

A whale of a problem



IFAW

Aerial Photogrammetry



Perryman & Lynn. 2002. J. Cetacean Research and Management



First boat-based operations



Durban et al. 2015. Journal of Unmanned Vehicle Systems

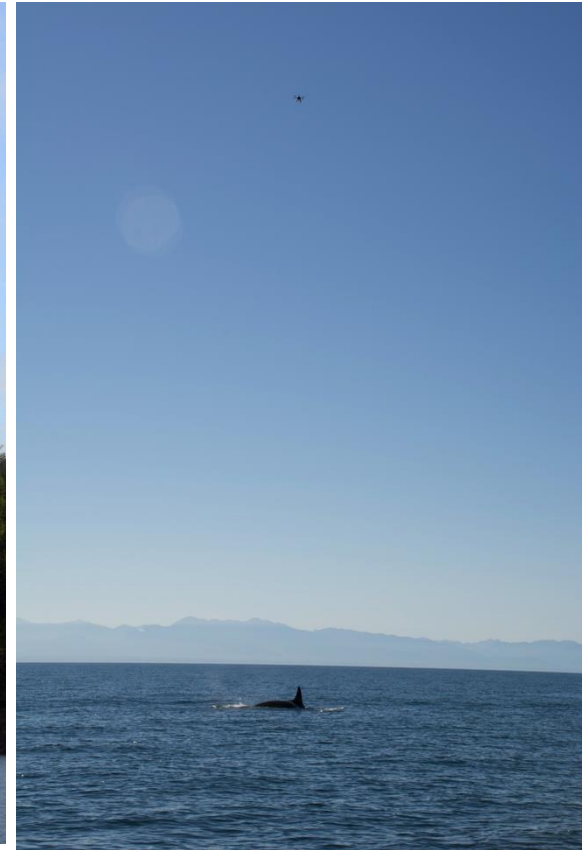
A team effort



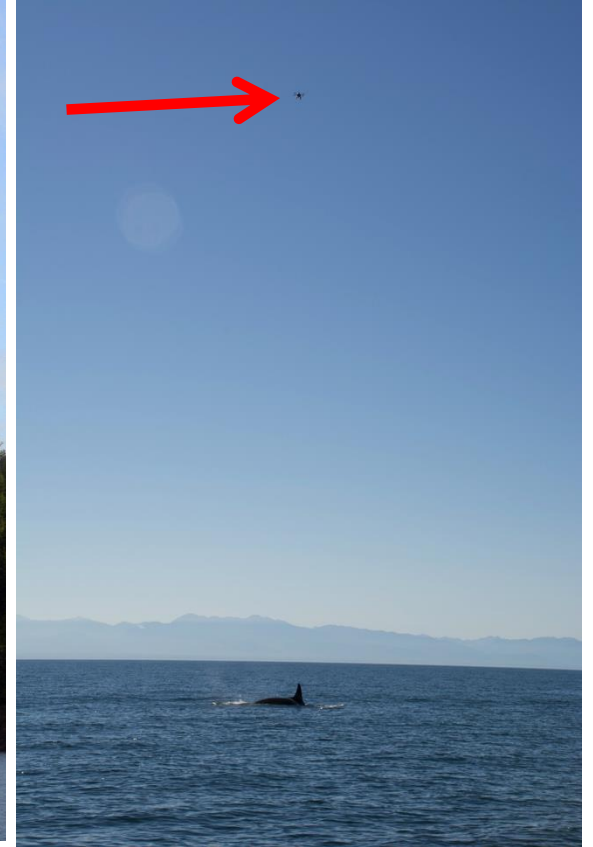
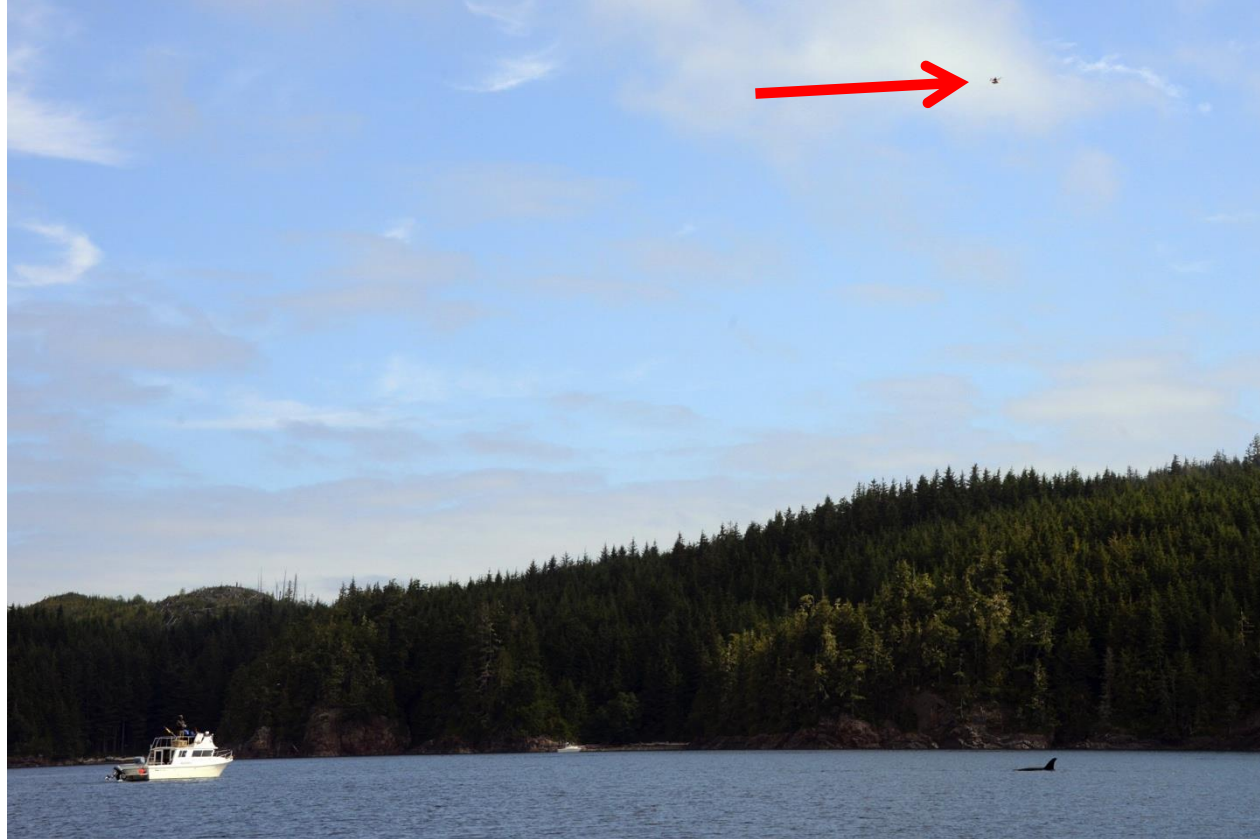
High-quality images



Non-invasive



Non-invasive



Journal of
Unmanned Vehicle
Systems

Revue des
systèmes de véhicules
télécommandés

Volume 3

2015

www.nrcresearchpress.com

An NRC Research
Press Journal

Une revue de
NRC Research
Press

The Journal of Unmanned Vehicle Systems is the official journal of Unmanned Systems Canada.

La revue des systèmes de véhicules télécommandés est la revue officielle de Systèmes Télécommandés Canada.

The Kenneth M Molson Foundation is a founding sponsor of the journal.

La Fondation Kenneth M Molson est un commanditaire-fondateur de la revue.

U.S. +

Live TV

Drone shows life and death of killer whales

Brad Lendon, CNN

Updated 9:33 PM ET, Sun October 19, 2015

Photos: Killer whales from above

4 of 6

Show Caption

Ship-based operations



Durban et al. 2016. Marine Mammal Science

View this journal online at <http://www.wileyonlinelibrary.com/journal/mms>

Marine Mammal Science



**Vol. 32, No. 4
October 2016**

**Published by the
Society for Marine Mammalogy**

A transferable tool: >1000 missions

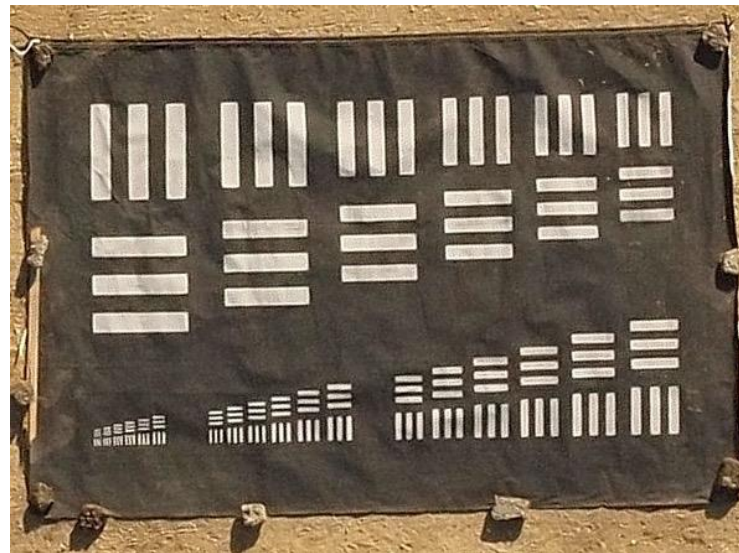


Resolution

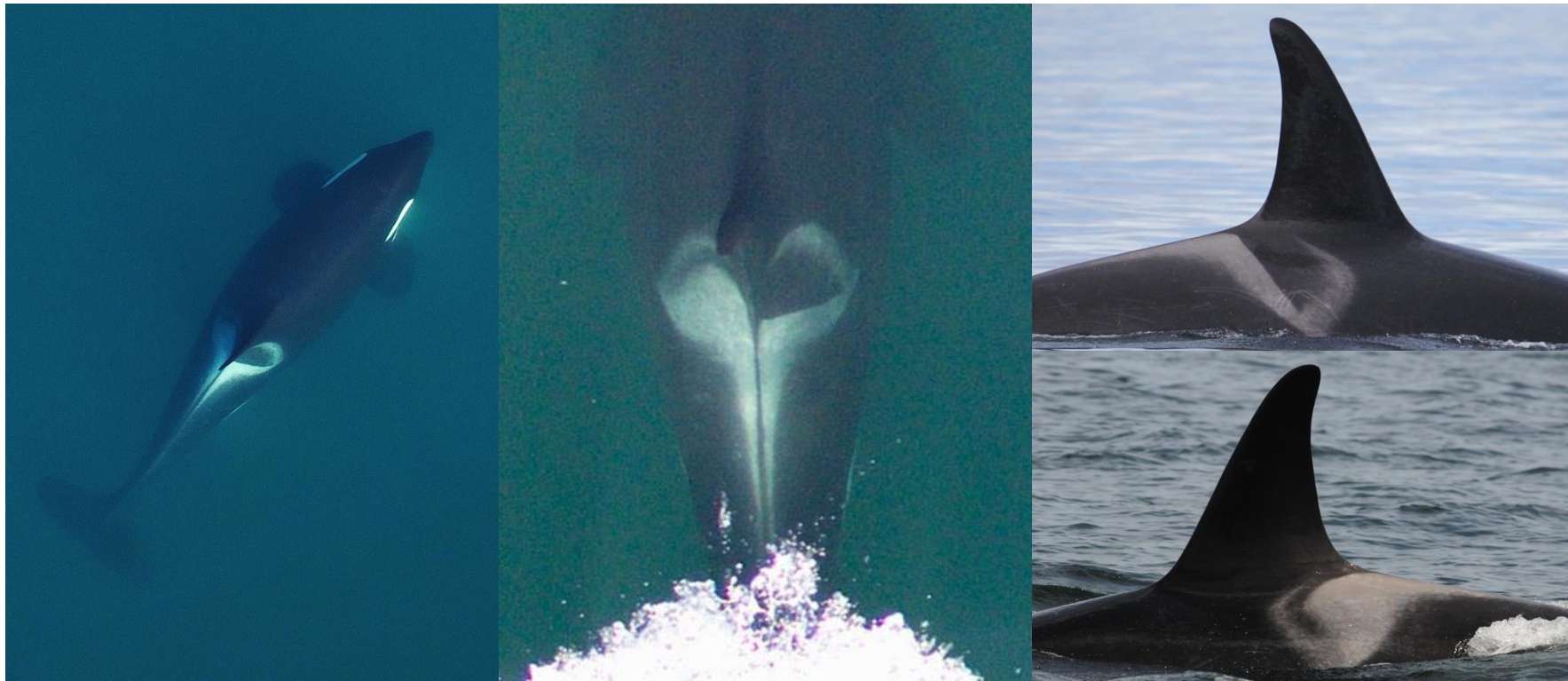


<1.8cm at 60m

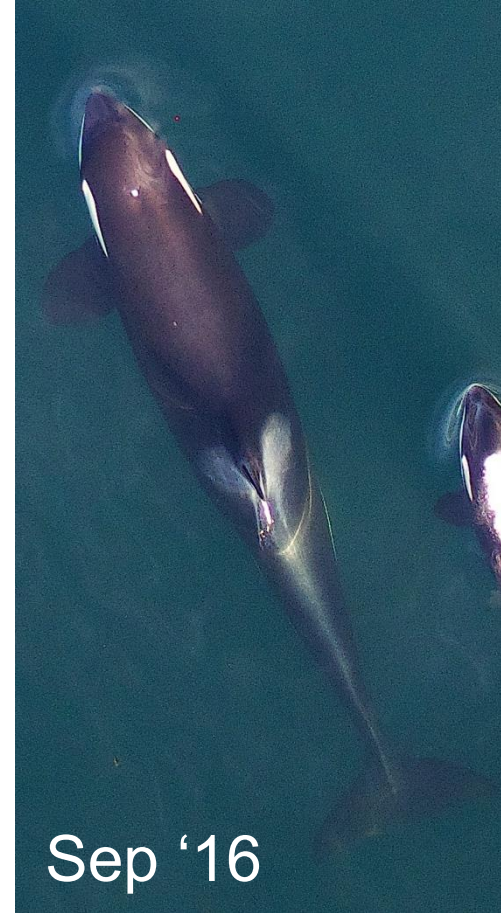
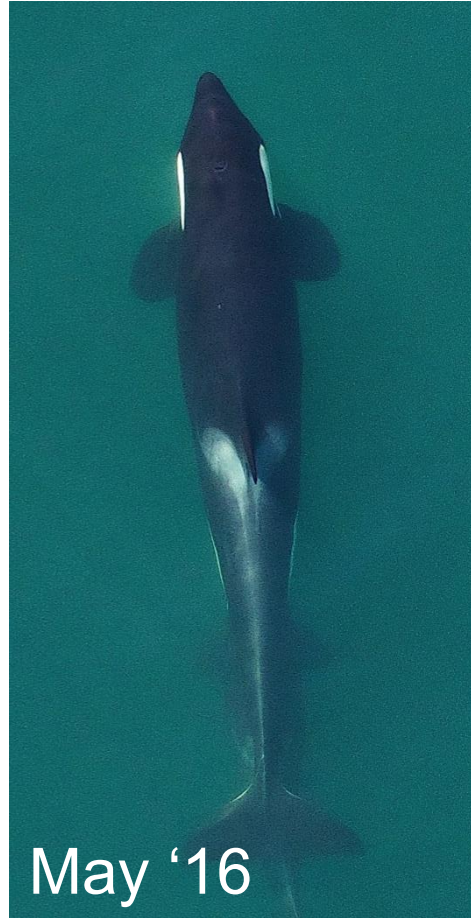
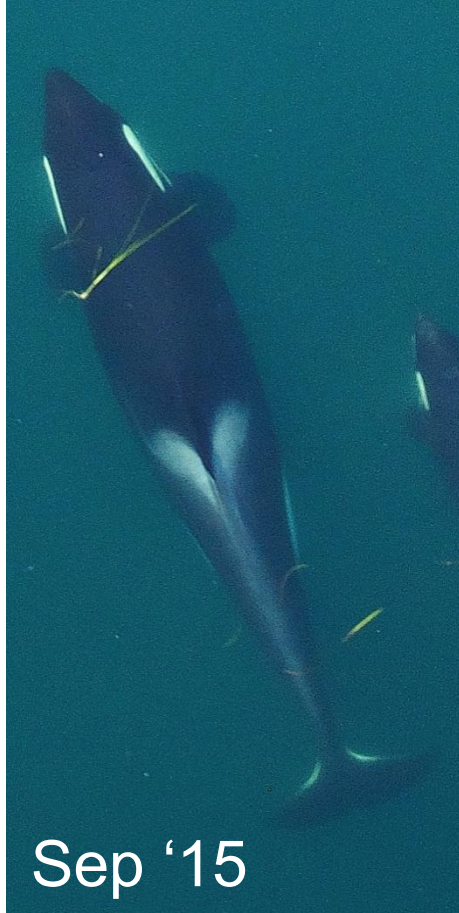
<1.4cm at 30m



Individual identification



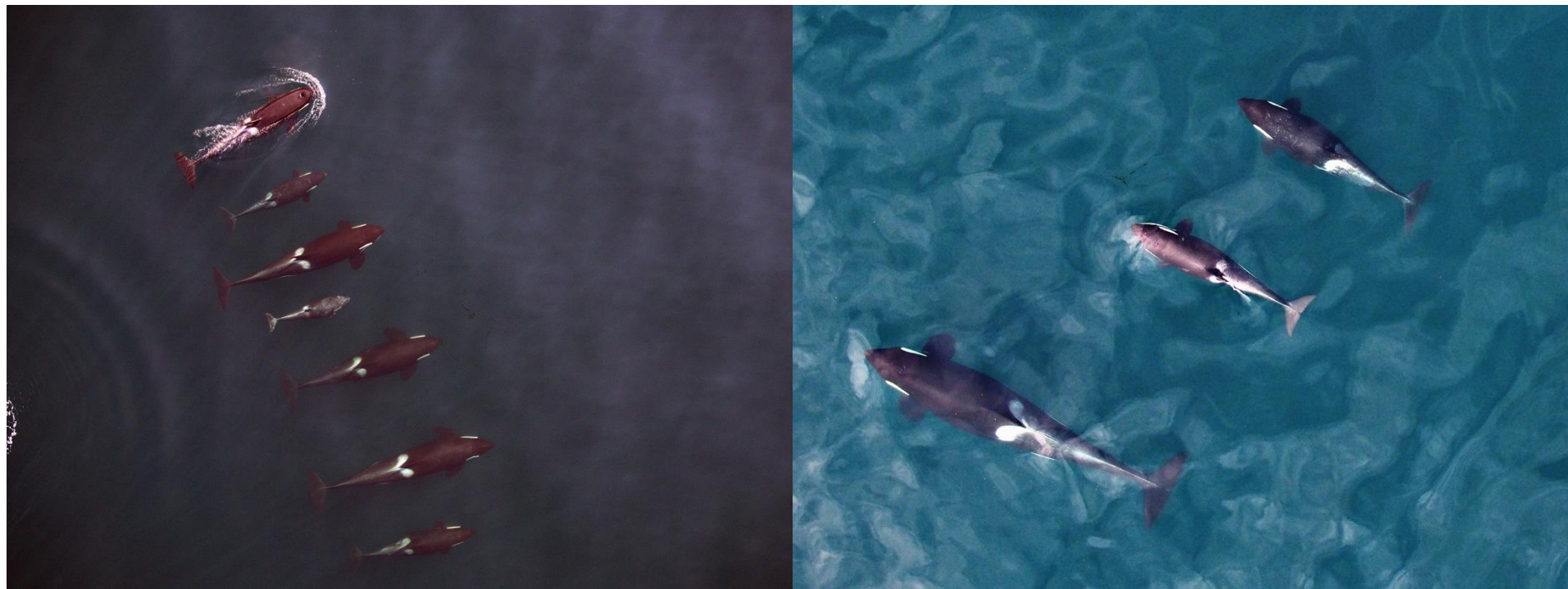
Detecting changes in condition



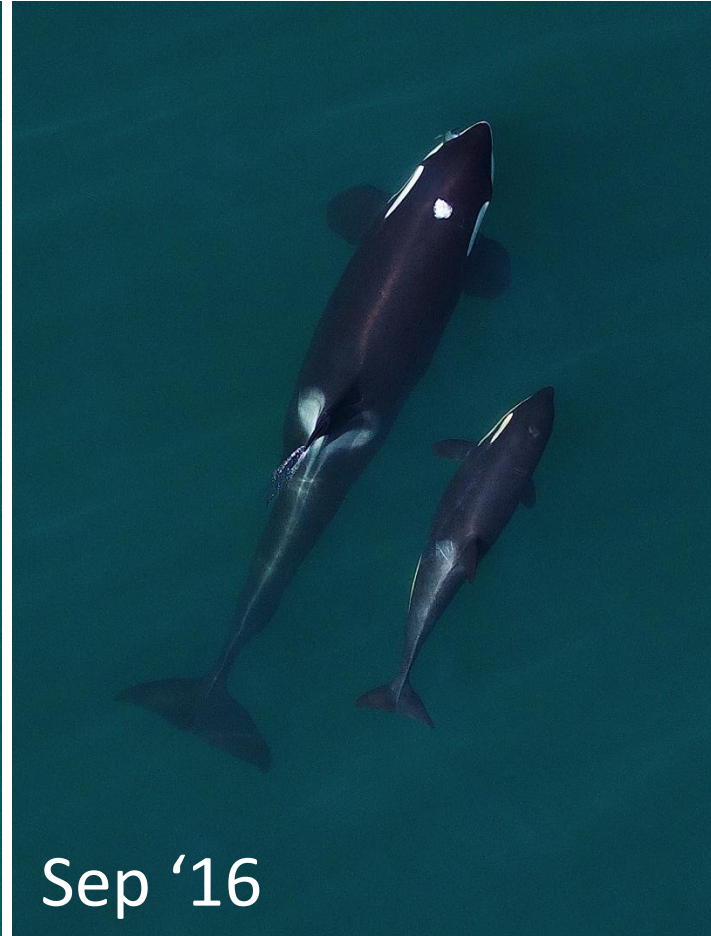
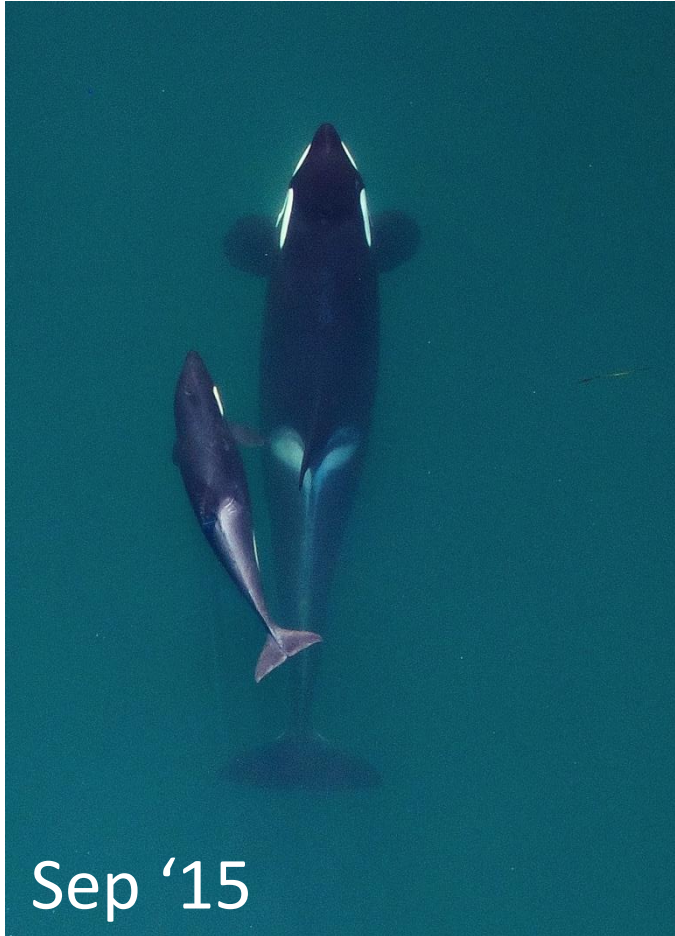
Detecting pregnancies



Visualizing growth



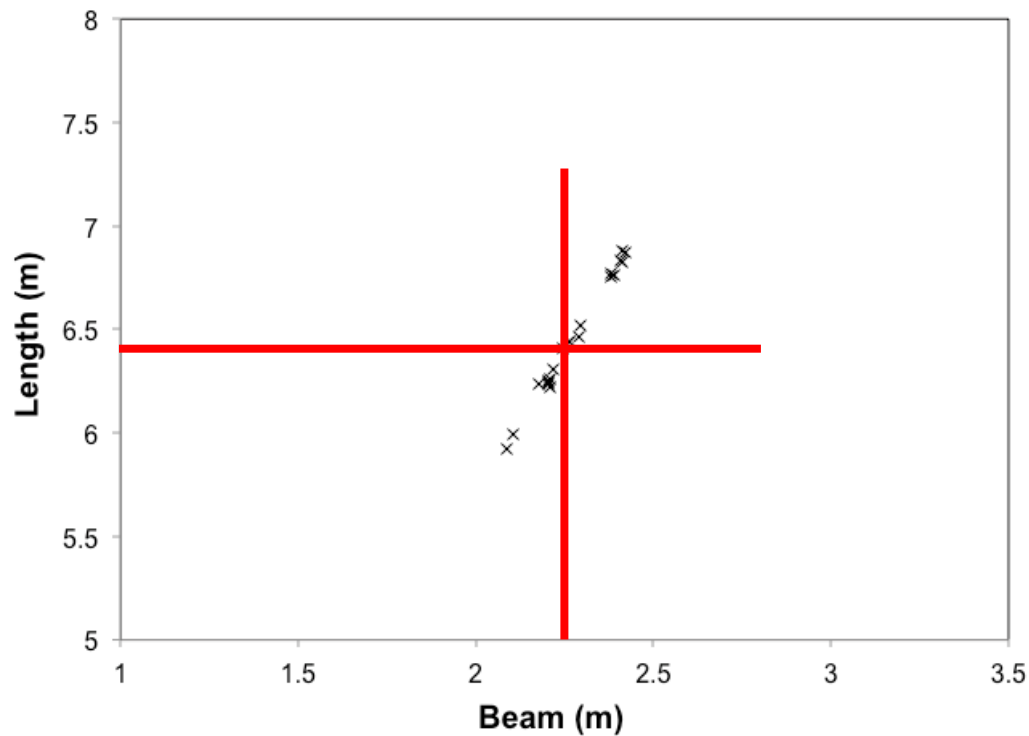
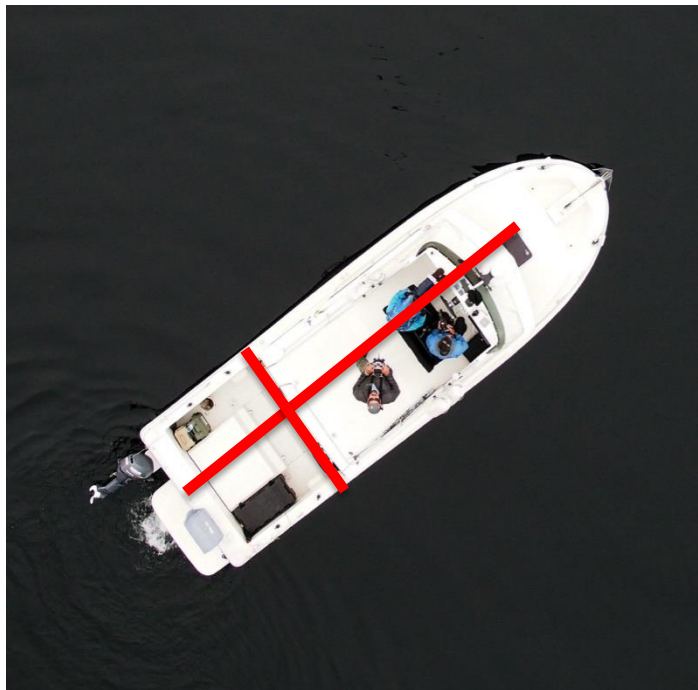
Visualizing growth



Scale calculations



Average error $<1\%$ (6cm length, 3cm beam); range $\pm 5\%$

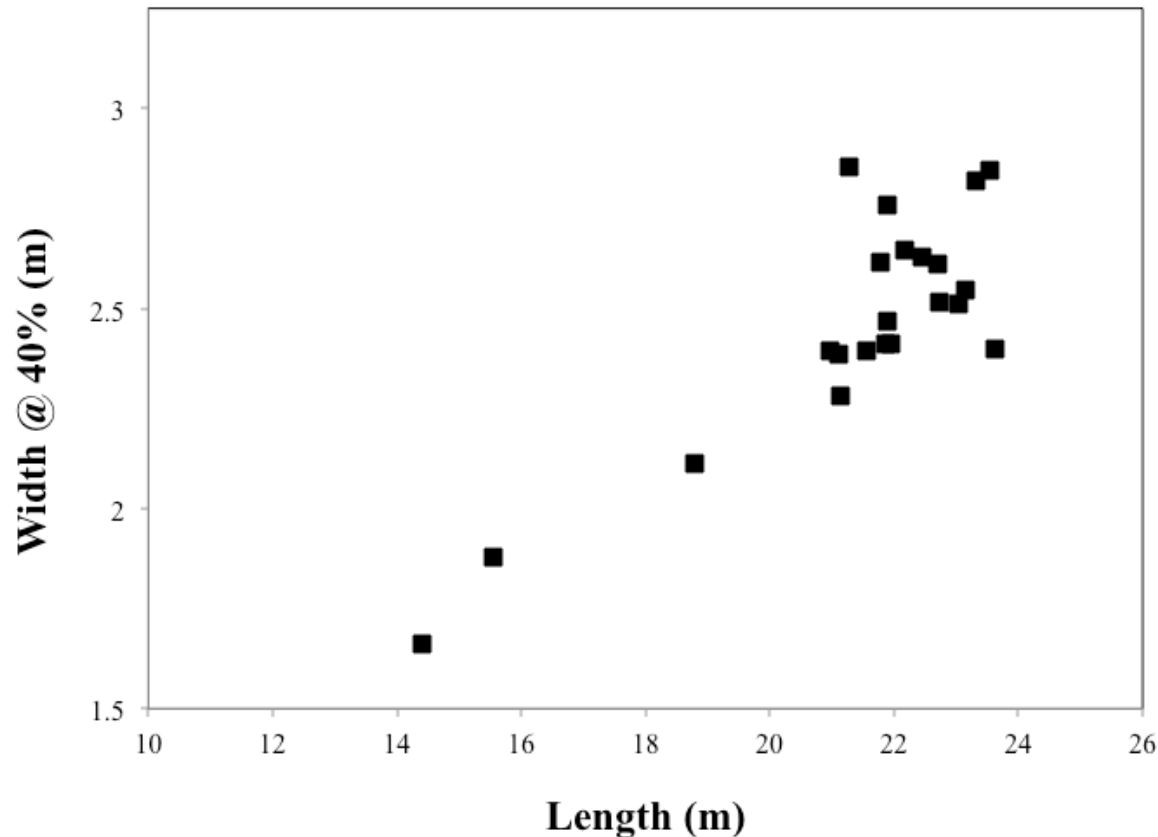


Size and condition of blue whales



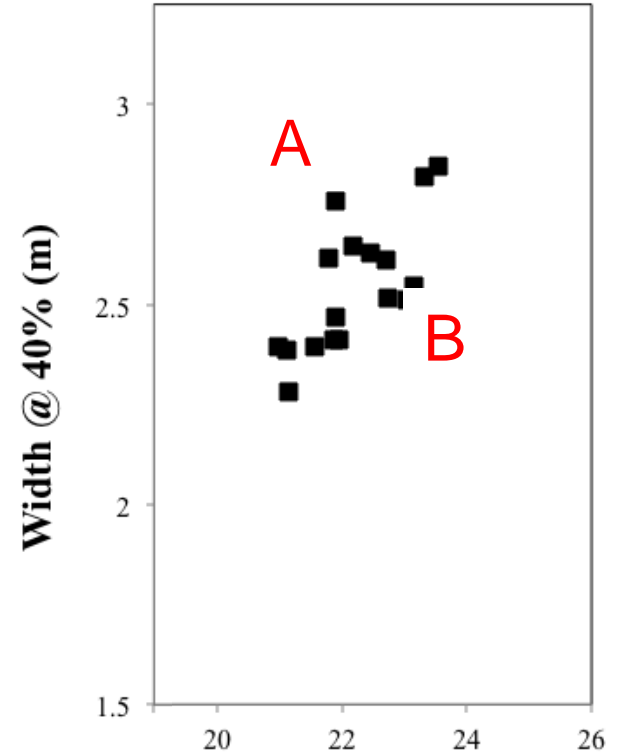
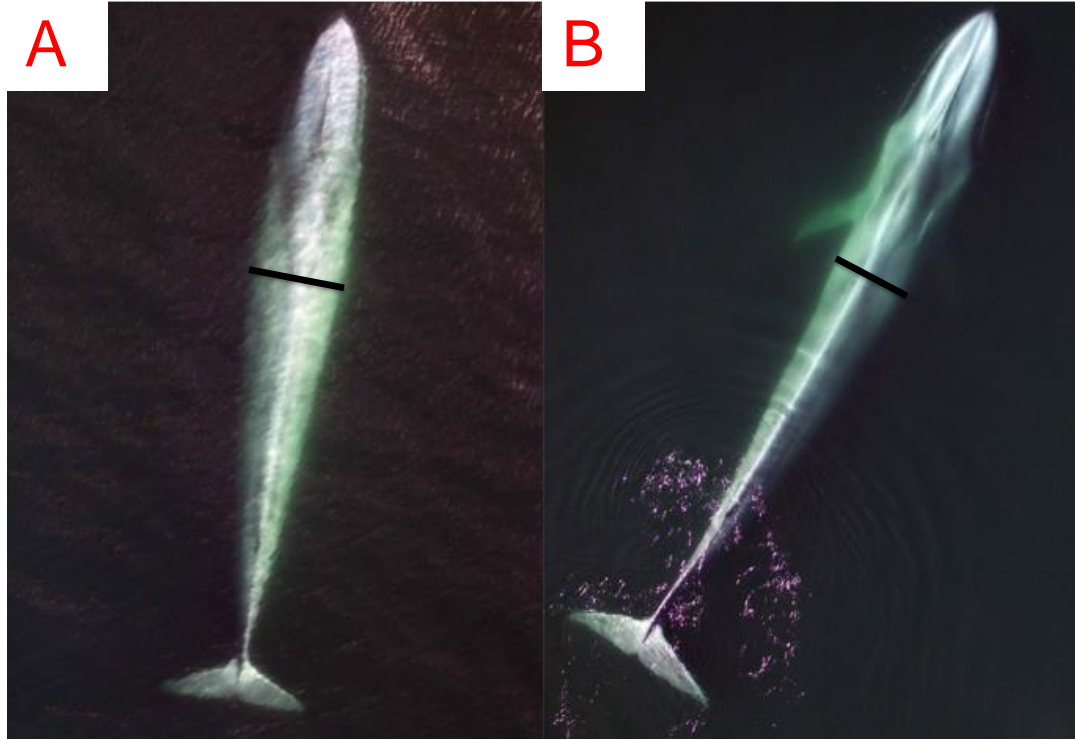
24m max (79ft!)

Variable widths

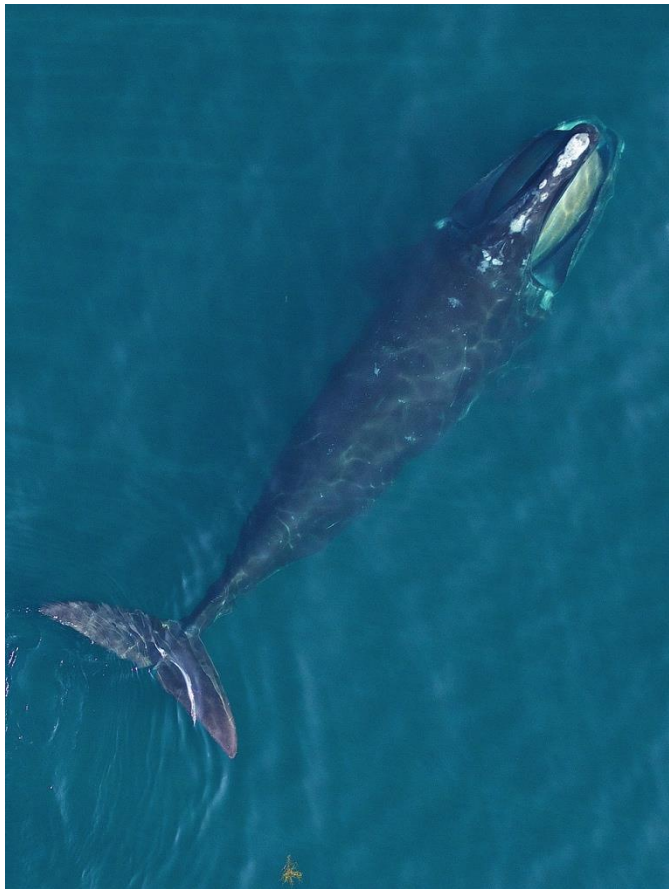


Durban et al. 2016. Marine Mammal Science

Size and condition of blue whales



Monitoring growth: North Atlantic right whales



New England Aquarium Special Section:
The North Atlantic Right Whale Catalog

[Scroll Through All Whales](#) [Search For Individual Whales](#) [Return to Right Whale Projects](#)

1 of 1 whales that match search criteria

Whale Summary

Catalog No:	1703	Whale Name:	WOLF	Sex:	Female	Year of Birth:	1987
Calving Female:	Yes	Mother:	1157	Last Year Seen:	2015	Death Year:	

Whale Composite [View Sightings](#)

Scar
1987 Calf Of 1157
Small bit of callus

Whale Images (Click an image for a larger view)

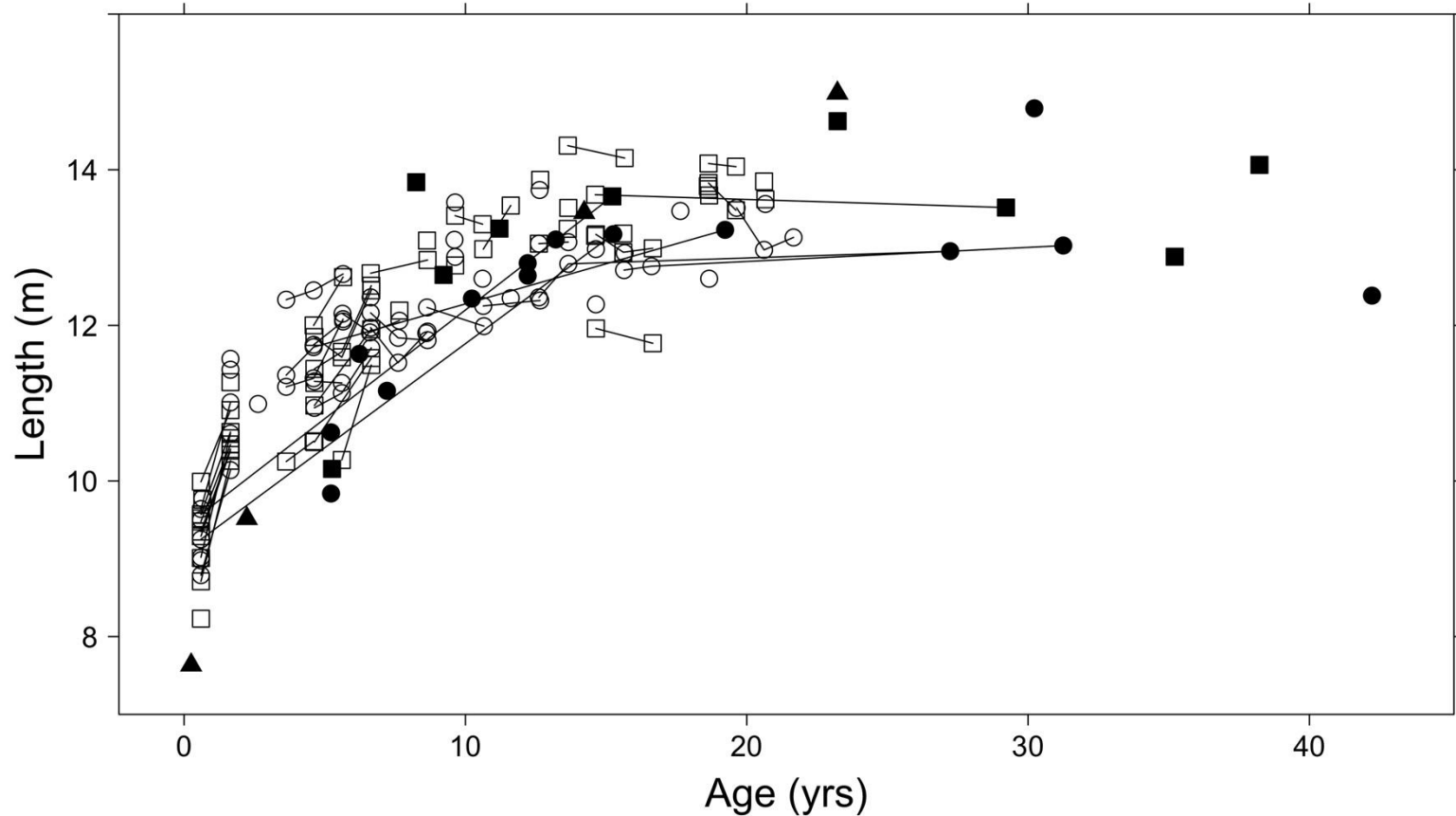
Body Part Filter: [<All Body Parts>](#)

[2001/09/12 NEA](#)

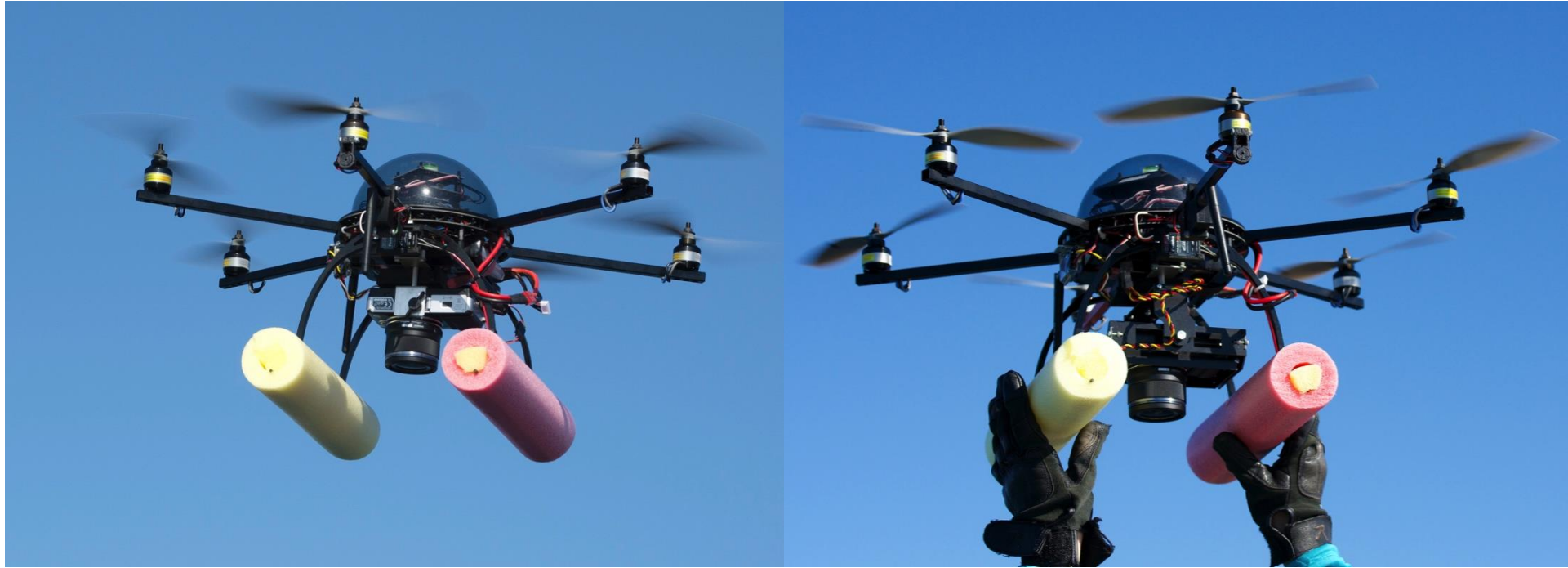
[2005/08/12 NEA](#)

[2005/07/31 WHOI/NP](#)

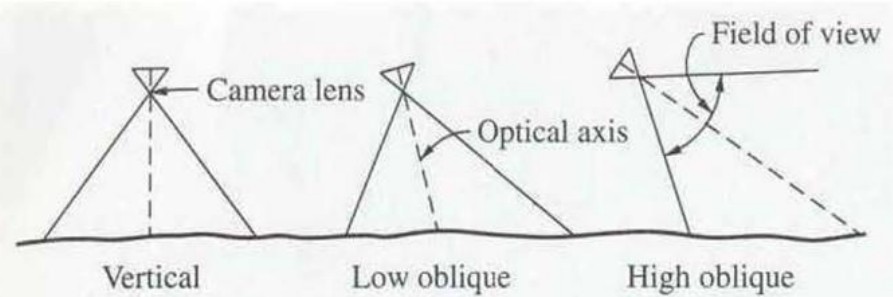
Monitoring growth in right whales



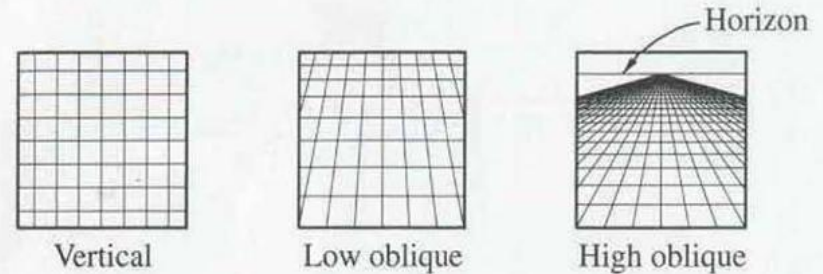
Improvements: gimbal camera mount



Reducing photogrammetry biases



Camera orientation for various types of aerial photographs



How a grid of section lines appears on various types of photos

Gimbal performance: 15% endurance loss



Without gimbal:

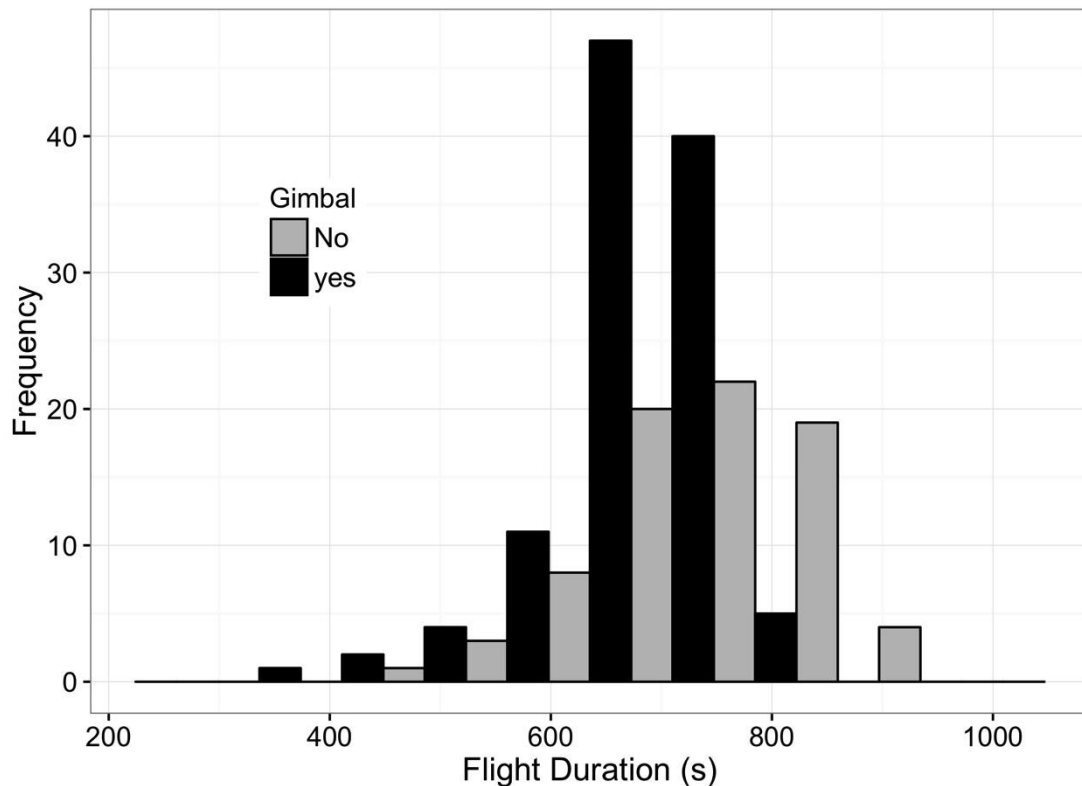
77 flights

Average = 12.7 mins

With gimbal:

110 flights

Average = 10.8 mins

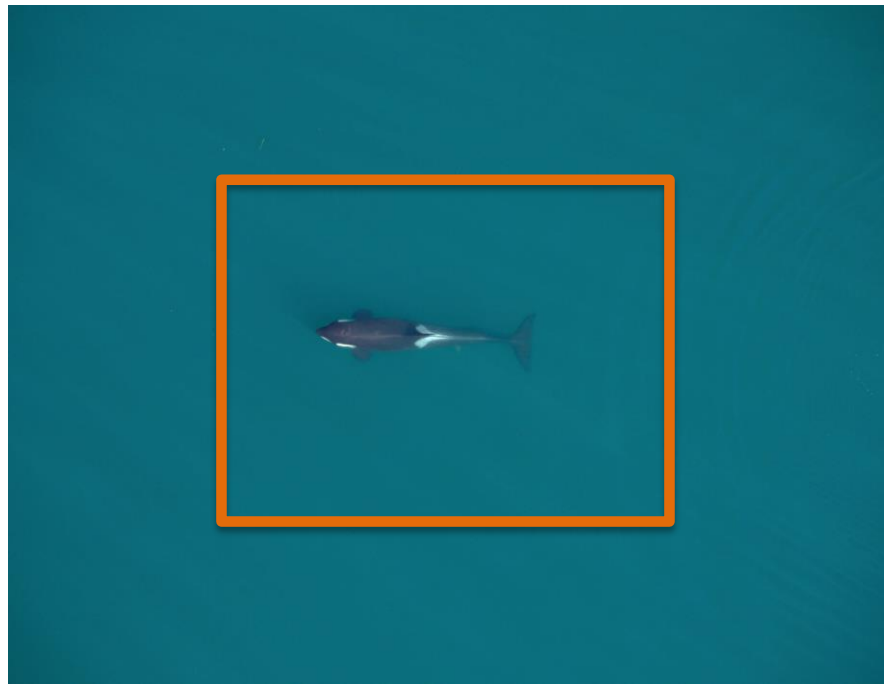
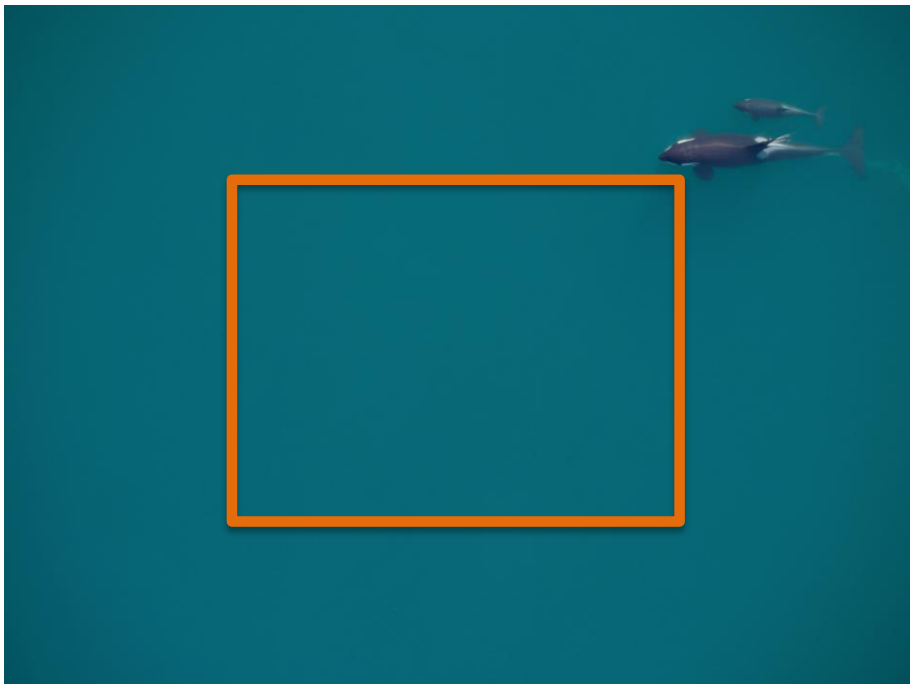


Gimbal performance: 27% efficiency gain



Without: $290/453 = 64\%$

With: $192/211 = 91\%$



Thanks!



SWFSC: Holly Fearnbach, Wayne Perryman, Morgan Lynn

Vancouver Aquarium: Lance Barrett-Lennard

Woods Hole Oceanographic Institution: Michael Moore

Aerial Imaging Solutions: Don LeRoi

NOAA AOC & OMAO

**NMFS Office of Science and Technology, NOAA UAS
Program**

Questions?

